

AUSTRALIAN TICKS.

By E. W. FERGUSON, M.B., Ch.M.

The attention of the public has recently been directed to two aspects of the tick problem—the poisonous effects of the scrub tick in human beings, and the outbreak of tick fever in cattle in the Tweed River district.

It would seem advantageous, therefore, to briefly review the present state of knowledge of our Australian ticks, including all the described species, as well as those of known noxious habits.

Ticks belong to the class ARACHNIDA, which includes the spiders and scorpions, and to the order ACARINA, which comprises both mites and ticks. With the mites—many of which are of interest, both from the medical and economic aspects—I do not propose to deal in this article.

The classification of the ticks has been the subject of much discussion, which will be found in Nuttall, Warburton, Cooper, and Robinson: "Ticks, a Monograph of the *Ixodoidea*," Part II., 1911. The arrangement there suggested is followed in what appears below. According to these authorities the ticks are included in the super-family IXODOIDEA Banks, which is further subdivided into the families ARGASIDAE and IXODIDAE.

In the ARGASIDAE the whole body is covered by a more or less uniform leathery integument, whereas the IXODIDAE possess a shield or scutum which covers the whole back in the male but only forms a small patch on the anterior part of the dorsum of the female. In the ARGASIDAE the capitulum—which includes the "biting" apparatus—is ventral in position, and may be completely concealed from above; in the IXODIDAE it is anterior and visible in its entirety. There are other differences between the two families which need not be further enumerated here.

Life History.—The tick passes through four separate stages in its life history—egg, larva, nymph, and adult. The larvae possess only three pairs of legs, and the nymph may be distinguished from the adult by the absence of the genital pore. Beyond this general scheme the life histories of different species vary greatly, particularly in regard to the relationship of the species to their hosts.

Too little is known in this respect of the life histories of Australian ticks, and, with one exception, the life history has not been fully worked out of a single native species.

Several different types of life histories are known among ticks. Thus in some species (*e.g.*, *Boophilus australis*) all the stages are passed on the one animal, the female only dropping off when replete. In other cases (*e.g.*, *Ixodes*) each stage, when replete, drops from the host, ecdysis taking place on the ground. In still other cases the larval and nymphal stages may be passed on the one individual, the nymph dropping off when replete.

In some instances ticks appear to attack numerous animals indiscriminately; in other cases they are more or less rigidly restricted to a species or group of closely related species of animals; or the larva, or larva and nymph, may be

confined to one species and the other stages to another, or may attack other animals indiscriminately.

ARGASIDAE.—Two genera (*Argas* and *Ornithodoros*) are admitted by Nuttall, Warburton, Cooper, and Robinson (1908), though these authors state that the differences between the two are less obvious than was formerly considered the case, intermediate species having been found that tend to bridge the gap between the type species of the two genera (*loc. cit.*, p. 3). The chief distinction lies in the lateral margin of the dorsum, which in *Argas* is distinctly flattened with a structure different from the general integument, this margin giving the body a sharp edge which is never completely obliterated even when the tick is replete; in *Ornithodoros* the margins are thick and ill-defined, not differing in structure from the rest of the integument and disappearing on distension. The capitulum is ventral in *Argas* and quite invisible from above; in *Ornithodoros* it is subterminal and the anterior portions often visible dorsally in the adult.

Both genera contains species which are of great economic importance, being carriers of spirochaetes, which are the casual organisms of disease in human beings and animals. Thus *Spirochaeta marchouxi*, the cause of spirochaetosis in fowls, may be transmitted by *Argas persicus*, *A. reflexus*, and *Ornithodoros moubata*. *Spirochaeta duttoni*, the causal organism of West African relapsing fever, is conveyed by *Ornithodoros moubata*, and it is now generally considered that relapsing fever in Persia and other parts of Western Asia is carried by *Argas persicus*.

Argas persicus (Oken), 1818.—This cosmopolitan species has been introduced into Australia, and is now well established, probably in all the States. It is a denizen—in this country, at any rate—of fowl houses and coops, and is commonly termed the fowl tick.

As the vector of the causal organism of fowl spirochaetosis, this species is of considerable economic importance. A full account of the life history will be found in Nuttall, Warburton, Cooper, and Robinson (1908). The eggs are laid in the hiding places of the adults, in cracks and crevices in the walls (*op. cit.*, p. 81). Hatching takes place in about three weeks. The larvae drop off the fowl after feeding, and by moulting change to the nymphal stage, after which the nymphs attach themselves to a fresh host. Two moults take place in the nymphal stage, the adult tick emerging after the second moult.

A second species (*Argas reflexus* Fabr.) is included by Rainbow in his "Synopsis of Australian *Acarina*" (1906). The geographical distribution, according to Nuttall and Warburton, is Europe and Northern Africa. As the species is a common parasite of the pigeon, it might easily be introduced.

Argas vespertilionis (Latr., 1796).—The bat tick is recorded by Taylor (1913, p. 73) from Townsville.

Argas lagenoplastis Froggatt, 1906, was described by Froggatt from the nests of the fairy martin or bottle swallow, *Lagenoplastes ariel*.—I have obtained this tick from the nests of the same bird at Rooty Hill, near Sydney. It is of interest, as being the only native species of the genus.

Ornithodoros talaje (Guerin, 1849).—This species is the only member of the genus recorded from Australia. It has a wide distribution, and frequents native houses, attacking man. A variety or distinct species (*capensis*) has been described which was found in penguin nests off the coast of South Africa. A specimen of this species was taken by Dr. J. B. Cleland from the little penguin (*Eudyptula minor*) in Western Australia. At least one other undescribed species of *Ornithodoros* occurs in Australia.

IXODIDAE.—Various attempts have been made to split up the IXODIDAE into separate tribes. It is not necessary here to discuss the question, and the ar-

rangement of genera given by Nuttall and Warburton (1911) has been followed. These authorities divide the Ixodidae into two sections.

I. *Prostriata*; with anal grooves surrounding the anus in front. Genus *Ixodes*.

II. *Metastriata*; with anal grooves surrounding the anus behind. Genera: *Haemaphysalis*, *Dermacentor*, *Rhipicentor*, *Rhipicephalus*, *Margaropus*, *Boophilus*, *Hyalomma*, *Amblyomma*, *Aponomma*.

Aponomma is regarded by Nuttall and Warburton as only a sub-genus of *Amblyomma*, while *Boophilus* is regarded by many as a sub-genus of *Margaropus*.

The genera may be separated by the following key, which is extracted from the characters given by Nuttall and Warburton for the different genera.

{	With anal grooves contouring the anus in front (<i>Prostriata</i>)	<i>Ixodes</i> .
	With anal grooves contouring the anus behind (<i>Metastriata</i>)	1
1 {	Capitulum short (<i>Brevirostrata</i>)	2
	Capitulum long (<i>Longirostrata</i>)	7
2 {	Festoons present; anal grooves well marked . . .	3
	Festoons absent; anal grooves obsolete	6
3 {	Eyes absent	<i>Haemaphysalis</i> .
	Eyes present	4
4 {	Basis capituli reetangular dorsally; no ventral plates or shields	<i>Dermacentor</i> .
	Basis capituli hexagonal	5
5 {	No ventral shields in the ♂	<i>Rhipicentor</i> .
	Adanal shields present in the ♂	<i>Rhipicephalus</i> .
6 {	♂ with median ventral plate	<i>Margaropus</i> .
	♂ with adanal and accessory adanal plates . . .	<i>Boophilus</i> .
7 {	♂ with adanal shields	<i>Hyalomma</i> .
	♂ without adanal shields, sometimes with small plaques near festoons	8
8 {	Eyes present	<i>Amblyomma</i> .
	Eyes absent	<i>Aponomma</i> .

IXODES.

This genus is well represented in Australia by some eleven species, including the common bush tick (*Ixodes holocyclus*). The following keys comprise the Australian species, and are extracted from Nuttall and Warburton's keys to the genus.

Males.

{	Body with five posterior brushes of hairs . . .	<i>I. putus</i> .
	Body without such hairs	1
1 {	Legs inordinately long	<i>I. vespertilionis</i> .
	Legs moderately long	2
2 {	Anal grooves closed behind	<i>I. holocyclus</i> .
	Anal grooves open behind	<i>I. tasmani</i> .

Females.

{	Legs inordinately long (on bats)	<i>I. vespertilionis</i> .
	Legs moderate	1
1 {	Anal grooves convergent or closed behind . . .	2
	Anal grooves subparallel or divergent	4
2 {	With article 1 much enlarged	3
	Palps normal	<i>I. holocyclus</i> .

3	{	Scutum broader than long; anal grooves closed behind	<i>I. australiensis.</i>
		Scutum as broad as long; anal grooves convergent, but open behind, at least in replete females	<i>I. victoriensis.</i>
4	{	Coxæ practically unarmed	5
		Some of the coxæ with distinct spurs	9
5	{	Scutum broadest quite in front (on marine birds)	<i>I. putus.</i>
		" " near middle or posteriorly	6
6	{	Scutum broadest behind the middle	7
		" " near middle or a little anteriorly	<i>I. vestitus.</i>
7	{	Scutum broader than long	8
		" longer than broad	<i>I. fecialis.</i>
8	{	Palps with article 1 greatly enlarged on ventral aspect	<i>I. tasmani.</i>
		Palps with article 1 small	<i>I. ornithorhynchi.</i>
9	{	Spurs present on trochanters	<i>I. percavatus.</i>
		No spurs on trochanters	<i>I. eudyptidis.</i>

Ixodes holocyclus Neumann, 1899.—This well-known species, commonly called the bush tick or bottle tick, is widespread along the coastal region of Eastern Australia. The exact distribution has not yet been worked out. It is common around Sydney, but it does not appear to have been recorded from the Blue Mountain districts, though specimens are in the departmental collection from Banya Mountains in Queensland. Nuttall and Warburton record (1911, p. 237) the species from Western Australia, and also from India. The tick so prevalent in Northern Queensland probably belongs to this species, though no specimens are to hand. Taylor (1913, p. 71), however, records it from Cairns district. The question of distribution is of some importance, since it is probable that this species exerts a controlling influence on the establishment of the introduced fox in the coastal districts. It has been found on a large number of hosts, including marsupials (*Macropus* spp., *Phascogale*, *Perameles*), rodents (*R. rattus*), dogs, man and birds (*Pitta*, duck).

As an account of the life history of this species has been published recently by Mr. Clunies Ross, of the Veterinary School, University of Sydney, it is not proposed to enter fully into the subject here. It may be stated, however, that the three stages are passed on different hosts, the tick dropping to the ground after each stage. The so-called seed ticks, which occasionally attack human beings in large numbers (over 200 have been taken off a single individual), are the larval form.

The chief interest in the species lies in the toxic effects produced in man and dogs. As in the case of *Dermacentor venustus*, in British Columbia, it seems probable that the symptoms produced by this tick are due to a toxin elaborated by the tick, rather than to a specific organism introduced through the wound. This point is, however, still unsettled, though it is significant that repeated search of the blood and other tissues in affected dogs has, so far, failed to reveal any evidence of the presence of a parasite. In dogs the principal symptom is an ascending paralysis, affecting first the hinder extremities, so that the dog appears to drag the hind quarters. If the condition be recognised early, and the tick be found and removed, recovery may take place; otherwise it ends fatally, probably by paralysis of the muscles of respiration. The work of Dr. Sydney Dodd (1921) first firmly established that these cases of paralysis in dogs were due to *Ixodes holocyclus*, though, from practical experience, this species had been

incriminated as the cause for many years.

In human beings the symptoms are less definite in their course, and the records in the past have not been too satisfactory, and characterised generally by lack of authentic identification of the species.

Several fatal cases due to ticks have occurred in children, in one of which the species was authentically identified.

Ixodes fecialis, Warburton and Nuttall, 1909.—This species was described from a gorged female from *Dasyurus geoffroyi*, Western Australia. In the same paper a variety—*aegrifossus*—was described from an opossum (Queensland) and *Perameles obscura* (Western Australia). Later Nuttall (1916, p. 327) recorded the species from *Dasyurus viverrinus*, New South Wales, and also condemned the variety *aegrifossus* (p. 335), as intermediate forms were found between the type and the supposed variety.

Specimens in the departmental collection are from *D. viverrinus* and *Rattus rattus* (Sydney). The male is unknown.

Ixodes ornithorhynchi, Lucas, 1845.—Originally recorded from Tasmania, this species has been recorded by Nuttall (1916, p. 329), also from Western Australia and Victoria; in all cases specimens were taken on the platypus (*Ornithorhynchus anatinus*). In view of the apparent restriction of the species to this host, the record of *I. ornithorhynchi* from Marianne Islands (Nuttall and Warburton, 1911, p. 242) must be viewed with suspicion. The male is unknown.

Ixodes tasmani, Neumann, 1899.—Described from (a) specimens collected by Verreaux (1847) in Tasmania; (b) specimens from the Island of St. Pierre (Ponafidin ?); and (c) an unknown locality, the hosts being unknown.

Nuttall (1916, pp. 321-4) has redescribed the species and described the male, specimens being from *Trichosurus vulpecula*, Queensland, and *Dasyurus maculatus*, *Petauroides volans*, *Trichosurus vulpecula*, and *Phascogale cinereus* Victoria. Specimens in the departmental collection from an opossum (Eidsvold, Queensland), appear to belong to this species.

Ixodes vestitus, Neumann, 1908.—Described from Western Australia from *Myrmecobius fasciatus*; also recorded from a snake (*Diemenia superciliosa*). The characteristic clothing of stiff hairs should make this species easily recognisable. The male is unknown.

Ixodes australiensis, Neumann, 1904.—Described from Western Australia as occurring on *Canis familiaris*; also recorded as occurring on *Bettongia lesueri*. The species has the first palpal joint much enlarged, as is the case in the next species.

Ixodes victoriensis, Nuttall, 1916.—Described from two gorged ♀ from a wombat (doubtless *Phascogale mitchelli*), Victoria. The species is allied to *I. australiensis* (Neumann), but differs therefrom, especially in the structure of the capitulum, scutum and tarsi.

Ixodes putus (Pickard-Cambridge, 1878).—"This species has a remarkably wide geographical distribution. As yet it has only been found parasitic on marine birds or infesting their breeding places, where it occasionally attacks man" (Nuttall and Warburton, 1911, p. 260). Among the records occurs King Island (Tasmania ?). This species is, however, recorded by Nuttall (1916, pp. 330-1) as occurring commonly on various species of penguins and the sooty albatross on Macquarie Island.

Ixodes percaratus Neumann, 1906.—Recorded by Nuttall (1916, p. 329) from Perth, Western Australia from a ♀ taken by Prof. J. B. Cleland on a penguin (*Eudyptula minor*). In forwarding this specimen Prof. Cleland noted that

the specimen had been identified as *I. eudyptidis* by Neumann.

Ixodes eudyptidis Maskell, 1885.—This species, referred by Nuttall and Warburton (1911, p. 284) to their list of doubtful species, has been resuscitated by Nuttall (1916, p. 320), who has examined a co-type of *I. eudyptidis*, Maskell. This author has determined it as the species so identified by Neumann (1899, p. 128) and later described by Nuttall and Warburton (1, c.p. 217) as *I. neumanni*. Neumann himself degraded two other names—*I. praeceoxalis*, Neumann, 1899, and *I. intermedius*, Neumann, 1899—to the rank of synonyms of *I. eudyptidis*, Maskell.

The species was originally described from New Zealand, but Nuttall (1916, p. 327) records it from *Eudyptula minor* from various places off the New South Wales coast and from Flinders Island, Bass Strait. Specimens from *Eudyptula minor* from Western Australia were identified by Neumann as this species, but one at least of these has been referred by Nuttall to *Ixodes percaratus*, Neumann (*vide supra*).

Ixodes vespertilionis Koch, 1844.—This world-wide species is recorded by Nuttall and Warburton (1911, p. 277) from *Vesperugo tricolor*, South Australia. The species is limited to bats.

Two other species of *Ixodes* found on marine birds may be found to occur in Australia—*I. auritulus*, Neumann, 1904, recorded by Nuttall (1916, p. 315) from *Aptenodytes patagonica* and *Megalestris antarctica*, Macquarie Island, and *I. unicaratus*, Neumann, 1908, recorded by Nuttall (1916, p. 334) from *Diomedea exulans*, Antipodes Island.

HAEMAPHYSALIS.

The following keys to the Australian species are extracted from the keys of the genus given by Nuttall and Warburton (*loc. cit.*, p. 353):—

Males.

- | | |
|---|---|
| { Coxal spurs normal and inconspicuous | |
| { One or more coxae strongly spurred (only coxa | |
| { IV. with a long spur, palpal article 2 with | |
| { ventral spur) <i>H. spinigera</i> var. <i>novae-guineae</i> . | |
| 1 { | Palpal article 3 with dorsal spur, more or less |
| | erect <i>H. bispinosa</i> . |
| " { | " " with no such spur 2 |
| | |
| 2 { | Scutum with surface irregular, very coarsely |
| | punctate <i>H. papuana</i> . |
| " { | " otherwise 3 |
| | |
| 3 { | Scutum markedly elongate 4 |
| | " short-oval <i>H. bancrofti</i> . |
| 4 { | Each palp long and narrow <i>H. humerosa</i> . |
| | " conical, article 2 being broad basally . <i>H. leachi</i> . |

Females.

- | | |
|---|---|
| { Palpal article 3 with distinct dorsal spine, more | |
| { or less erect <i>H. bispinosa</i> . | |
| { Palpal article 3 without dorsal spine, but pos- | |
| { terior border may protrude 1 | |
| 1 { | Scutum much longer than broad 3 |
| | " only slightly or not longer than broad .. |
| 2 { | Palp much longer than broad <i>H. humerosa</i> . |
| | " short-cone shaped, as broad as long . . . <i>H. leachi</i> . |
| 3 { | Palpal article 3 with distinct ventral spur . . . <i>H. papuana</i> . |
| | " " with no spur, or at most a |
| { slight point <i>H. bancrofti</i> . | |

Of the species recorded from Anstralia, two—*H. bispinosa* and *H. leachi*—are probably introduced and possibly, as Nuttall and Warburton suggest, with Indian cattle. Excluding these two species, these authors allow two species for Australia, but have apparently overlooked their own record of *H. spinigera* var. *novae guineae* from Australia. The Australian record of *H. papuana* is possibly erroneous, but the species is included in the table on the strength of Tryon's records, and since it occurs in New Guinea there is no reason why it should not be found to occur in Australia. *H. longicornis* (Nenmann, 1901) is not included in the table, being regarded by Nuttall and Warburton as a doubtful species.

Haemaphysalis leachi (Audouin, 1827).—Neumann recorded this species from New South Wales, the specimens from a horse having been sent by the Agricultural Department. Froggatt (1900, p. 542) states that the specimens were taken on horses and cattle at Grafton and Wallangarra. Neumann (1905, p. 258) erected a variety *australis* for the Australian specimens, and later (1911, p. 115) made the variety into a sub-species. Nuttall and Warburton (1915, p. 467), however, do not regard the supposed differences as more than variations which may occur in a series from other localities. This species is widely distributed in Africa and Southern Asia, and has doubtless been introduced into Australia. An account of the life history is given in Nuttall and Warburton (1915, pp. 536–542). The species requires three hosts upon which to feed during its larval, nymphal and adult stages. The larva and nymph remain attached to the host for three to seven days, and the females from eight to sixteen days. The males may remain on the host for many weeks.

H. leachi is the carrier in Africa of canine piroplasmosis, a very fatal disease in dogs. The organism is imbibed by females when sucking the blood of an infected animal; it then undergoes development in the tick and penetrates the eggs. The larvae and nymphs, though infected, are not capable of transmitting the disease, but the adults are, and may remain so after fasting for several months.

Taylor records the species from Ching Do, Northern Queensland, taken on *Macropus agilis*.

Haemaphysalis bispinosa Neumann, 1897.—This species has a widespread distribution in India, Burma, Malay States, China, Japan and Borneo, and has been recorded from East Africa. It is not uncommon in the north coastal districts of New South Wales, and specimens from horse (Ballina) and calf (Bouville) sent from this laboratory are recorded by Nuttall and Warburton. The species has also been introduced into New Zealand, where it is now the common cattle tick. An account of its life history will be found in an article "The Cattle Tick (*Haemaphysalis bispinosa*)" by J. G. Myers, in the *New Zealand Journal of Agriculture*, XXVII., p. 67, 1923. The species is a "three-host" tick, cattle being the chief hosts, but other animals, including some of the introduced small birds, are infected. The winter is passed as a nymph hidden at the base of rushes and clumps of rough grass.

Haemaphysalis bancrofti Nuttall and Warburton, 1915.—These authors record this tick from *Macropus giganteus* and *M. dorsalis* from the Burnett River district, and from *Bettongia penicillata*, also from Queensland. Specimens in the departmental collection from Eidsvold (Burnett River district), taken off a rock wallaby (*Macropus* sp.), are apparently referable to the same species. All stages—larva, nymph, adult (♀)—are known, but the life history has yet to be worked out, and also whether the species is responsible for the transmission of any parasites.

Haemaphysalis humerosa, Warburton and Nuttall, 1909.—This species has

apparently a wide distribution in Australia, originally described from *Parameles macrura*, Barrow Island, North-west Australia. It has been recorded from the Northern Territory from the same host; and from Sydney off *Perameles nasuta*. Nymphs, and adults (♂) are known.

Haemaphysalis spinigera var. *novae-guineae* (Hirst, 1914).—Originally described as a distinct species, Nuttall and Warburton (1915, p. 449) have degraded *novae-guineae* to a variety of the Asian *H. spinigera* (Neumann, 1897). It was described from marsupials from German New Guinea, but Nuttall and Warburton also record it from a kangaroo, Northern Territory.

Haemaphysalis papuana Thorell, 1882.—Canestrini (1884, p. 705) determined a tick from Queensland as this species. Nuttall and Warburton (1915, p. 404) state that his determination is probably wrong, or else the figure he gave is incorrect. The species is recorded by Tryon (1917-1919) from Queensland, in the latter instance as infesting cattle.

Haemaphysalis longicornis Neumann, 1901.—A doubtful species, described originally from two ♀ found on cattle at Kempsey, New South Wales. Neumann later (1905, p. 257) degraded the species to a variety of *H. concinna* (Koch, 1844), and in 1911 (p. 111) raised it to the rank of a sub-species. Nuttall and Warburton (1915, p. 512) regard this identification as open to grave suspicion, as *H. concinna* is scarcely to be identified in the absence of the characteristic ♀. Froggatt (1900, p. 542) states that specimens were taken on cattle at Narrabri and Kempsey.

DERMACENTOR.

One species—*Dermacentor atrosignatus* Neumann, 1906, is doubtfully recorded as Australian. *Ixodes coralis*, Gervais, 1842, may possibly also belong to this genus. In the present state of knowledge it seems extremely doubtful if the genus occurs in Australia.

RHIPICEPHALUS.

Rhipicephalus sanguineus (Latreille, 1804).—The common European dog tick, this species has been recorded (6 ♂, 5 ♀) by Neumann (1897, p. 389) from a dog from Queensland. The tick is recorded by Tryon (1917-1919) as occurring in the Northern Territory and in Queensland, in the latter instance as infesting dogs. The species is of importance, as it is the vector of canine piroplasmosis (*P. canis*) in India and probably throughout Asia, Southern Europe and North Africa (Nuttall, 1913, p. 309).

This genus is often regarded as a sub-genus of *Margaropus*; one species is found in Australia.

BOOPHILUS.

Boophilus annulatus australis (Fuller, 1899).—The well-known cattle tick of Queensland is generally regarded as a variety of the Texas Fever tick (*B. annulatus*, Say, 1821), and is evidently an introduction into Australia, possibly, as suggested by Gilruth, from Batavia in 1872. It was first discovered near Darwin in 1880-81, from whence it spread into Queensland and over practically the whole of that State, except the dry inland areas. It has also established itself in northern New South Wales.

The importance of *B. annulatus australis* lies in the fact that it is the vector of *Piroplasma bovis*, the causal organism of bovine piroplasmosis, commonly known as tick fever or redwater fever; which has been the cause of serious economic loss. All stages of the tick may be found on the host at the one time as ecdysis occurs on the animal; the replete female drops off the beast to lay its eggs, which average in number about 3,000. The eggs having hatched, the larvae crawl up grass stems, vegetation, fences, etc., to await a host. Apart from

conveying infection, these ticks may cause deterioration and even death by infestation of a beast in enormous numbers—tick worry. An extensive literature has grown up on the economic aspect and should be consulted for full details as regards life history, symptoms, prevention, treatment, disinfestation, etc.

HYALOMMA.

A single species of this genus has been introduced into Australia; there are no native species.

Hyalomma aegyptium (Linneus, 1758).—This species is recorded by Taylor (1913, p. 71) from dogs, Townsville, Queensland. The species was also taken by J. B. Cleland on camels in Western Australia.

AMBLYOMMA.

This genus is represented in Australia by six described species, which occur on marsupials, domestic animals, and reptiles. The following keys to the Australian species is extracted from the table in Patton and Cragg (1913, p. 612), given as after Neumann.

Males.

1	{	Scutum with marginal groove completely contouring the posterior border	<i>A. triguttatum.</i>
		Scutum with incomplete marginal groove (formed of punctations or not contouring the posterior border)	1
1	{	Scutum with marginal groove continuous	2
		Scutum with a light border, and marginal groove formed of punctations	3
2	{	Scutum with reddish yellow patches, marginal grooves commencing posterior to the eyes . .	<i>A. moreliae.</i>
		Scutum coloured brown, marginal grooves commencing on a level with the eyes	<i>A. australiense.</i>
3	{	Scutum with broad border interrupted, festoons with very fine punctations	<i>A. limbatum.</i>
		Scutum with uninterrupted straight border, festoons with large punctations	<i>A. albolimbatum.</i>

Females.

1	{	Coxa 1 with unequal spurs	1
		Coxa 1 with equal or subequal spurs	4
1	{	Scutum as broad as long	2
		Scutum much broader than long	<i>A. postoculatum.</i>
2	{	Porose areas with prominent borders, and as large as the eyes	<i>A. triguttatum.</i>
		Porose areas without prominent borders, smaller than the eyes	3
3	{	Scutum without spots, lateral grooves fine, and formed of punctations	<i>A. australiense.</i>
		Scutum with five light spots, without lateral grooves	<i>A. limbatum.</i>
4	{	Scutum as broad or hardly broader than long . .	<i>A. albolimbatum.</i>
		Scutum much broader than long	<i>A. moreliae.</i>

Amblyomma albolimbatum, Neumann, 1906.—This species occurs commonly on reptiles; specimens in the departmental collection were taken from the tiger snake, stumpy-tailed lizard (*Trachysaurus rugosus*), and “bob-tailed goanna”—the latter specimens are from Geraldton, Western Australia (J. Clark, 29th November, 1912). The original specimens were taken on *Trachysaurus rugosus*.

Amblyomma moreliae (Koch, 1867).—This species, described from the carpet snake, occurs commonly on reptiles; specimens are in the collection of the Health Department from a carpet snake, Brisbane, tiger snake and brown snake, Sydney. Taylor (1913, p. 72) records the species from the green spinifex snake, Northern Territory. Neumann recorded it from the horse and kangaroo.

Amblyomma triguttatum, Koch, 1844.—This species has been recorded from a number of hosts, including the platypus (*Ornithorhynchus*), kangaroo, horse and ox.

A gorged ♀ from the ox is in the departmental collection, also two ♀ from red kangaroo, Wagrakine, Western Australia.

Froggatt (1900, p. 541) records it from the following localities in New South Wales:—Barham (paddymelon), Dubbo (cattle), Narrabri (dogs and cattle).

Amblyomma australiense, Neumann, 1905.—Described from the echidna. Taylor (1913, p. 72) records it from Townsville from the same host.

Amblyomma limbatum, Neumann, 1899.—Described from six ♂ from King Island, and two ♀ Adelaide.

Amblyomma postoculatum, Neumann, 1899.—Also described from King Island from a single ♀ received with the ♂ of *A. limbatum*. No host is recorded for either species.

APONOMMA.

This genus is regarded by Nuttall and Warburton as a sub-genus of *Amblyomma*. It is well represented in Australia, and at least one species is of very common occurrence on lizards (*Varanus*).

Males.

{	Scutum without marginal grooves	<i>A. ecinctum</i> .
	Scutum with marginal grooves	1
I {	Tarsi without subterminal humps	<i>A. trachysauri</i> .
	Tarsi with subterminal humps	2
{	Scutum with punctate marginal grooves, and with reddish spots	<i>A. decorosum</i> .
	2 { Scutum with deep lateral grooves, brownish red without spots	<i>A. hydrosauri</i> .

Females.

{	Scutum with three metallic spots	<i>A. trimaculatum</i> .
	Scutum uniformly reddish brown, without green spots	1
I {	Scutum heart shaped (lateral angles towards the anterior third)	<i>A. ecinctum</i> .
	Scutum triangular (lateral angles towards the anterior fourth)	2
2 {	Scutum broader than long; porose areas sub-triangular and subcontiguous	<i>A. trachysauri</i> .
	Scutum as long as broad	3
{	Hypostome with 6 rows of teeth; porose areas small, round, close, at a subtangent to the posterior border of basis capituli	<i>A. decorosum</i> .
	3 { Hypostome with 8 rows of teeth; porose areas large, oval and remote from each other . . .	<i>A. hydrosauri</i> .

Aponomma decorosum (Koch, 1867).—This is much the commonest species and is to be taken practically on every specimen of "goanna" (*Varanus* spp.). The departmental collection contains specimens from *Varanus varius*, Dubbo, Junee; and *V. gouldi*, Cobar. Taylor (1913, p. 73) records the species from the echidna (*Tachyglossus aculeatus*), Townsville. Neumann recorded it from *V. giganteus*, Brisbane, from ? python, a snake and echidna, and also from Fiji.

Ixodes varani, Koch, is cited by Neumann as a synonym.

Aponomma trimaculatum (Lucas, 1878).—The records of this species include Sumatra and New Guinea (*Varanus leucostigma*) as well as Australia, a single ♀ is recorded by Neumann from *Bostaurus*, New South Wales. Taylor records it from *Varanus varius*, Townsville.

Aponomma hydrosauri (Denny, 1843).—Described from *Hydrosaurus* (= *Varanus*) *gouldi*, Tasmania. Neumann records it from *V. varius*, New South Wales.

A. concolor, Neumann, is given by Blanchard (1909, p. 136) as a synonym; it was recorded from the echidna, Queensland. Froggatt (1900, p. 541) states that it is the common lizard tick and records it from *V. varius*, Gonburn, and the echidna, Bombala.

Aponomma trachysauri (Lucas, 1861).—The species is doubtfully placed on the Australian list. The original specimens were taken on *Trachysaurus scaber* in the Menagerie of the Museum de Paris. *T. scaber* may be intended for *T. rugosus*, the stump-tailed lizard or shingle-back, which is the only species of *Trachysaurus*; Mr. J. R. Kinghorn, of the Australian Museum, is, however, unable to trace any use of the name *scaber* in the genus. There is also the possibility that the ticks may have become attached to the lizard while in captivity.

Aponomma cinctum, Neumann, 1901.—Described from specimens sent from the New South Wales Department of Agriculture. Froggatt (1900, p. 542) states that the species is common on *Aulacocyclus kaupii*—a passalid beetle. Neumann also recorded it from the Philippines.

Species of Doubtful Validity or Position.

Ixodes phascolomys, MacAlister, 1871.—Described from engorged females taken from a wombat (*Phascolomys*). Nuttall and Warburton (1911, p. 287) place it among the list of condemned species with a note "a purely nominal species." The figure is that of a replete female and so generalised that it might apply to almost any species of Ixodid tick. There are before me specimens of two species of ticks taken on the wombat. One is *Ixodes holocyclus*, represented by a single ♀; the other is represented by numerous males and replete and semi-replete females of a species of *Aponomma*, which does not appear to correspond with any of the described species of that genus. Another species of tick, *Ixodes victoriensis*, was described from the wombat by Nuttall in 1916.

Ixodes coralais, Gervais, 1842.—Of this species, which is placed in their condemned list Nuttall and Warburton (1911, p. 283) write:—"Judging from original description may be a *Dermacentor*, from New Holland." I have not seen the original description, but Neumann (1899, p. 157), who also tentatively refers it to *Dermacentor*, states that the species was taken on a skink.

List of Species with Hosts.

	Host.	State.
<i>Argasidae</i> —		
<i>Argas persicus</i>	Fowl	All States.
„ <i>vespertilionis</i>	Bats	Queensland.
„ <i>lagenoplastes</i>	<i>Lagenoplastes ariel</i> . .	N.S.W., Q.
<i>Ornithodoros talaje</i>	Penguin	West Australia.
<i>Ixodidae</i> —		
<i>Ixodes holocyclus</i>	Marsupials, dogs, sheep, rats, birds	Q., N.S.W., W.A.
„ <i>fecialis</i>	<i>Dasyurus</i> , <i>Perameles</i> , <i>Trichosurus</i> , <i>Rattus</i> .	West Aus., N.S.W., Q.
„ <i>ornithorhynchi</i>	<i>Ornithorhynchus</i>	N.S.W., Tas., Vic.
„ <i>tasmani</i>	<i>Trichosurus</i> , <i>Dasyurus</i> , <i>Petauroides</i> , <i>Phascolarctus</i>	Tas., Q., Vic.
„ <i>australiensis</i>	<i>Canis familiaris</i> , <i>Bettongia</i>	West Australia.
„ <i>victoriensis</i>	<i>Phascolomys</i>	Victoria.
„ <i>vestitus</i>	<i>Myrmecobius</i> , <i>Diemenia</i>	West Australia.
„ <i>putus</i>	Sea birds	King Island.
„ <i>eudypitidis</i>	<i>Eudypitula</i>	N.S.W., Flinders Is.
„ <i>peracatus</i>	<i>Eudypitula</i>	West Australia.
„ <i>vespertilionis</i>	<i>Vesperugo</i>	South Australia.
<i>haemaphysalis leachi</i>	Horse, cattle, <i>Macropus</i>	N.S.W., Queensland.
„ <i>bispinosa</i>	Horse, cattle	N.S.W.
„ <i>bancrofti</i>	<i>Macropus</i> spp., <i>Bettongia</i>	Queensland.
„ <i>humerosa</i>	<i>Perameles</i>	North-west Australia, N.S.W.
„ <i>spinigera</i> , var. <i>novae-</i> <i>guinaeae</i> .	<i>Macropus</i>	Queensland.
„ <i>papua</i>	Cattle	Queensland.
„ <i>longicornis</i>	Cattle	N.S.W.
<i>Dermacentor atrosignatus</i> .		? Australian.
<i>Rhipicephalus sanguineus</i> .	Dog	Queensland, N. Ter.
<i>Boophilus annulatus</i>	Cattle	Queensland, N.S.W.,
„ <i>australis</i>		Nor. Ter., North- West Aus., W.A.
<i>Hyalomma aegyptium</i> . . .	Camel, dog	West Aus., Q.
<i>Amblyomma albolimbatus</i> .	<i>Trachysaurus</i> , <i>Notechis</i>	N.S.W., West Aus.
„ <i>moreliae</i>	Snakes (carpet, brown, tiger, etc.), horse, and kangaroo.	Q., N.S.W., Northern Territory.
„ <i>triguttatum</i>	Horse, cattle, dogs, kangaroo, platypus .	N.S.W., West Aus.
„ <i>australiense</i>	Echidna	Queensland.
„ <i>limbatus</i>	Unknown	King Is., South Aus.
„ <i>postoculatus</i>	Unknown	King Island.
<i>Aponomma decorosum</i> . . .	<i>Varanus</i> spp., snakes, Echidna	N.S.W., Queensland.
„ <i>trimaculatum</i>	<i>Varanus</i> , cattle	Q., N.S.W.
„ <i>hydrosauri</i>	<i>Varanus</i> , Echidna . . .	Tas., N.S.W., Q.
„ <i>trachysauri</i>	<i>Trachysaurus</i>	? Australian.
„ <i>ecinctum</i>	Beetles	
“ <i>Ixodes</i> ” <i>phascolomys</i> . . .	Wombat	?
„ <i>cozalis</i>	Skink	?